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Accuracy of Early Stand Exam Age Estimates in the Swan Valley of Western Montana

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Abstract—Stand exams conducted in western Montana over 50 years ago provide a valuable source of information on prefire suppression and preharvest condition of the region's forests. Of the early exam estimates of stand origin, 52 percent were within 20 years of estimates taken from stand exams conducted in the 1980's, and 73 percent were within 60 years. There was no significant bias toward either higher or lower age estimates. The early stand exam data can give an accurate estimate of stand age distributions over large areas.

Keywords: presettlement vegetation, stand mapping

The desire to maintain sustainable ecosystems and protect biological diversity on public lands has sparked interest in presettlement stand-age distribution of Northern Rocky Mountain forests. As part of a nationwide Forest Survey effort authorized by the McSweeney-McNary Forest Research Act of 1926, the Forest Service conducted inventories of forested lands in western Montana and northern Idaho between 1932 and 1943 (USDA FS 1933, 1937-43). These inventories are potentially of great use in estimating presettlement stand-age distributions in areas where timber harvest did not begin and where fire suppression was ineffective prior to 1940. However, use of these early stand exam data depends on knowing the accuracy of the inventory methods. The purpose of our study is to assess the accuracy of the early stand exam age estimates by comparing them to estimates taken from more recent stand exams conducted in the 1980's.

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METHODS

Our study area encompassed all lands managed by the Forest Service in the Swan Valley, Lake, and Missoula Counties, MT. Our initial data base was all timber compartments in the Swan Lake Ranger District south of Swan Lake. We used only the subset of stands that had not been entered for harvest. From these, we randomly selected one stand from all subcompartments that had fewer than 25 unentered stands and two stands from all other subcompartments. This process gave us a preliminary sample of 156 stands.

The following information on methodology for the early stand mapping was gleaned from a progress report issued by the Northern Rocky Mountain Forest and Range Experiment Station (USDA FS 1937). The inventory, or land classification, phase of the Forest Survey project placed special emphasis on the total area covered by forest, forest cover types, and timber volume. During this inventory phase, 1:31,680 (2 inches:1 mile) township maps showing forest and nonforest types were prepared for western Montana and northern Idaho (fig. 1). The maps display "salient features" of each forest type: type of stand, species represented, average size of the dominant trees, volume range, average age, stand density or stocking, site index, and harvest information. Stands were assigned to 20-year age classes (except the oldest two classes, which were 160 to 200 years and more than 200 years). Age estimates were based on the stand cohort with the most basal area (Pissot 1993).

In compiling these maps, available cruise and type data were first collected from public agencies and private owners. The reliability of existing data was then checked, and the blanks were filled in to complete coverage of the region (USDA FS 1937). Mappers were required to make extensive cruises of the sawtimber stands that had not yet been examined and to label immature and nonmerchantable types. The minimum mapping unit for sawlog stands was

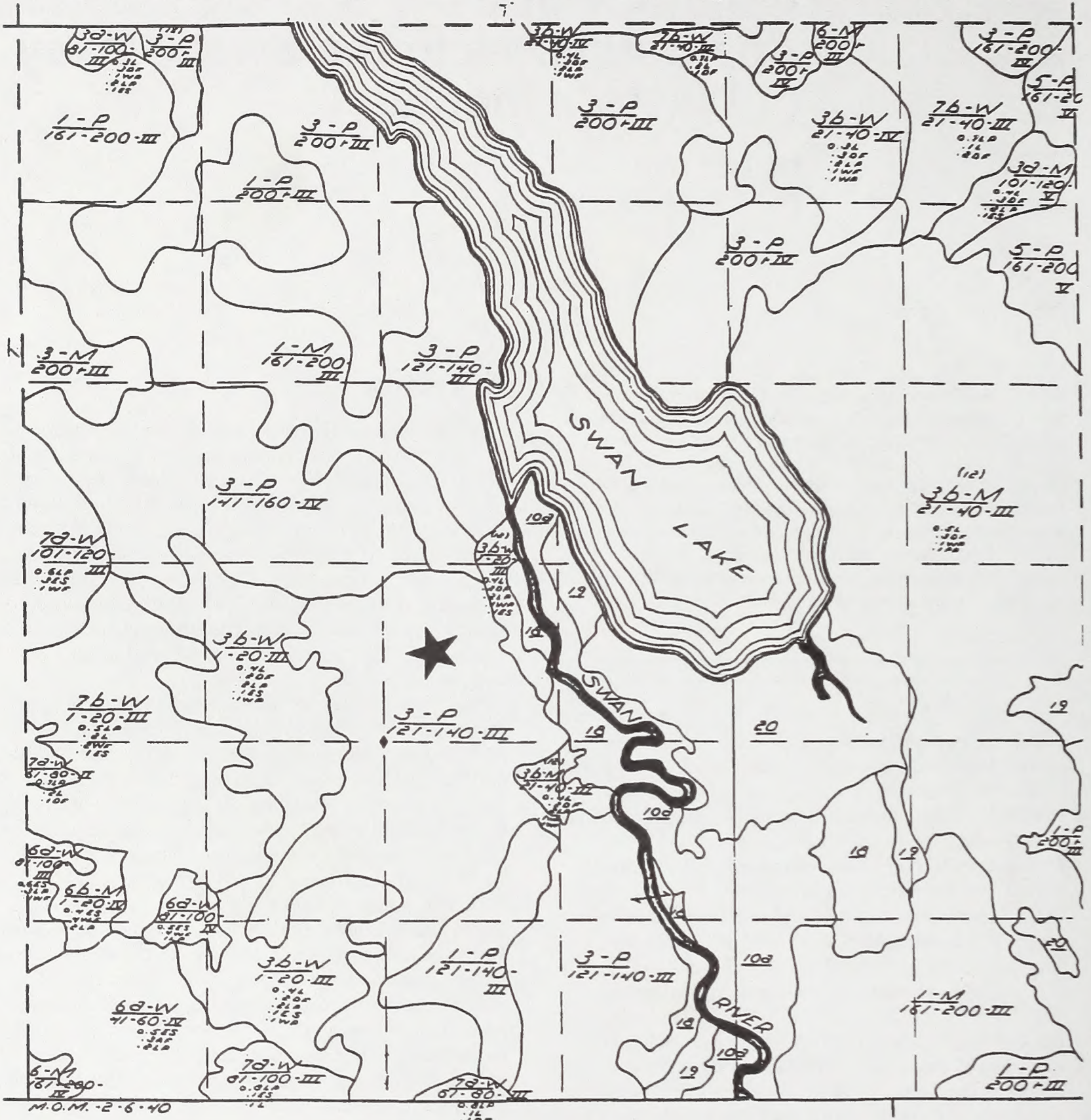


Figure 1—A sample township map for the Swan Valley. For the starred stand, 3 indicates a western larch/Douglas-fir cover type, poorly stocked (P), 121 to 140 years old, with a site class of III.

40 acres, and 100 acres for other forest lands. The mappers delineated stand boundaries from vantage points across the landscape, then traversed each stand sufficiently to classify it. Intensity of coverage depended on the forest type; for example, a merchantable stand required more attention than a younger one. Maps were drafted in the field and later checked

and completed in the office. There is no mention of the use of aerial photography in preparing the township maps, although photos from that period are known to exist, at least for much of our study area. The early mapping was conducted in the Swan Valley by numerous examiners prior to 1940. Most maps for our study area are dated 1937.

Modern stand age estimates were taken from stand exams conducted by Flathead National Forest personnel in the 1980's (see USDA FS 1991 for methods). We obtained estimates of stand age from exams by calculating the mean age of the oldest cohort, usually *Larix occidentalis*, *Pseudotsuga menziesii*, or *Pinus contorta*, rounded to the nearest 5 years. Occasionally, the stand exam would list one old tree, and the next oldest trees were more than 50 years younger. In these cases we consulted the exam narrative to determine how common the oldest trees were. In most cases, modern stand-age estimates were taken from the cohort with the most basal area and were not based on single outliers.

We plotted the location of the modern stands on the early stand exam maps and recorded the stand age given on the map. We used 1937 age class centroids in comparisons with estimates from modern stand exams except for the 200 years and older class, where 200 was used. We eliminated stands from the analysis if they fell into two 1937 stands of different ages or if they corresponded to a 1937 stand that was not assigned to an age class (for example, many sub-alpine stands). Eliminating these stands gave us a sample size of 115. We converted stand age to year of stand origin by subtracting the estimated age from the year of the survey. We then calculated the deviation between early and modern estimates by subtracting the modern estimate from the early one. In cases where the early exam date of origin was 1737 (200 years and older class) and the estimate from modern surveys was earlier than 1737, the difference was set to zero. We tested the hypothesis that there was a bias for higher or lower age estimates between the early and modern surveys with a nonparametric Wilcoxon signed ranks test. The probability value was calculated from a two-tailed normal approximation (Wilkinson 1986).

RESULTS AND DISCUSSION

Of the early exam estimates of stand origin, 52 percent were within 20 years of the modern estimates, and 73 percent were within 60 years (fig. 2). The early stand exams gave older estimates of stand age somewhat more often than younger estimates when compared with the modern exams; however, this bias was not significant ($P = 0.824$).

Early exam overestimates (negative deviations) were more common for young stands, while underestimates (positive deviations) were more common in older stands (fig. 3). However, this bias is more apparent than real. Overestimates of old stands were not possible because all stands over 200 years old were placed in the same age class. Large underestimates of stands younger than 100 years do not occur because they would require estimates of stand initiation dates later than the completion of the study.

This tendency will result in small underestimates of the proportion of very old and very young stands.

Many potential sources of discrepancy exist between the early and modern stand-age estimates. Methodology differed: stand examiners in 1937 may have cored the largest trees in each stand to obtain stand age, while modern examiners were more likely to have cored an average tree in each size class, and often relatively few large trees were cored in each exam. In these cases, early stand exam age estimates would tend to be greater. In instances where the oldest cohort was uncommon, early stand age was taken from the second oldest cohort. This situation would result in early exam underestimates.

Although we were able to factor out stands that had undergone human disturbances between the 1930's and 1980's, in some cases there may have been successional changes in stand age and structure during that period. For example, an uneven-aged stand dominated by 200-year-old grand fir (*Abies grandis*) in 1937 may have lost the oldest cohort during the ensuing 50 years, making stand age younger in the 1980's than the 1930's. This is probably an uncommon situation in the Swan Valley but should be noted by those considering applications of this data set in other areas.

Finally, modern stands are generally drawn at a finer scale with a much smaller minimum mapping unit than was used in the Forest Survey project. Stands as small as 2 or 3 acres may be delineated (Robinson 1993), as opposed to 40 acres for the 1937 stands (USDA FS 1937). Thus, remnant pockets of old trees within large areas of younger forest are more likely to be mapped today. This is a logical explanation for cases in which the early stand exams gave a much younger age than the modern exams. In addition, there were undoubtedly mapping errors associated with the early exams.

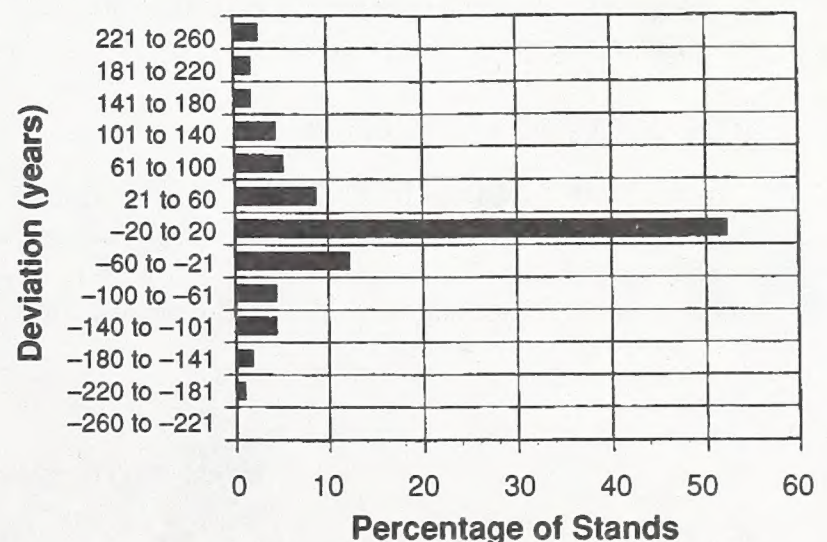


Figure 2—Deviation (in 40-year increments) of early stand exam estimates of stand origin from estimates based on modern stand exams.

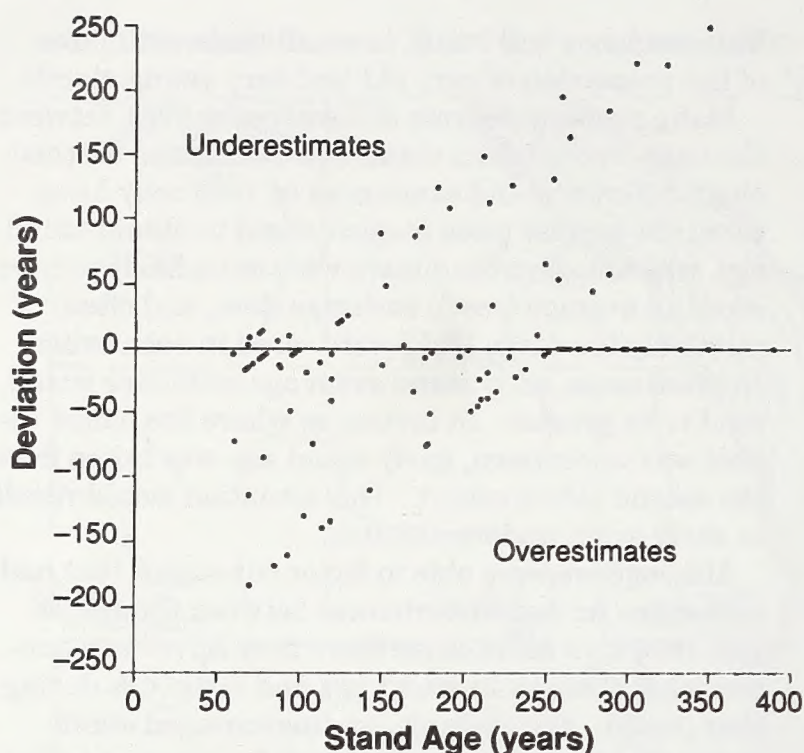


Figure 3—Deviations of early stand exam estimates from modern estimates as a function of stand age based on modern estimates.

Nonetheless, these early stand exams are of considerable value for determining general prefire-suppression and preharvest-stand-age distribution for many areas of western Montana. Estimates of date of origin for nearly three-fourths of the sample stands were within 60 years of the date estimated from modern exams. Furthermore, there was no bias toward overestimates or underestimates, and the distribution of discrepancies was symmetrical about zero. Overestimates of young stands and underestimates of older stands would tend to balance each other. As a result, the early stand exam data can be used with only limited confidence for any single stand but should give a reasonably accurate estimate of stand-age distributions over large areas.

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